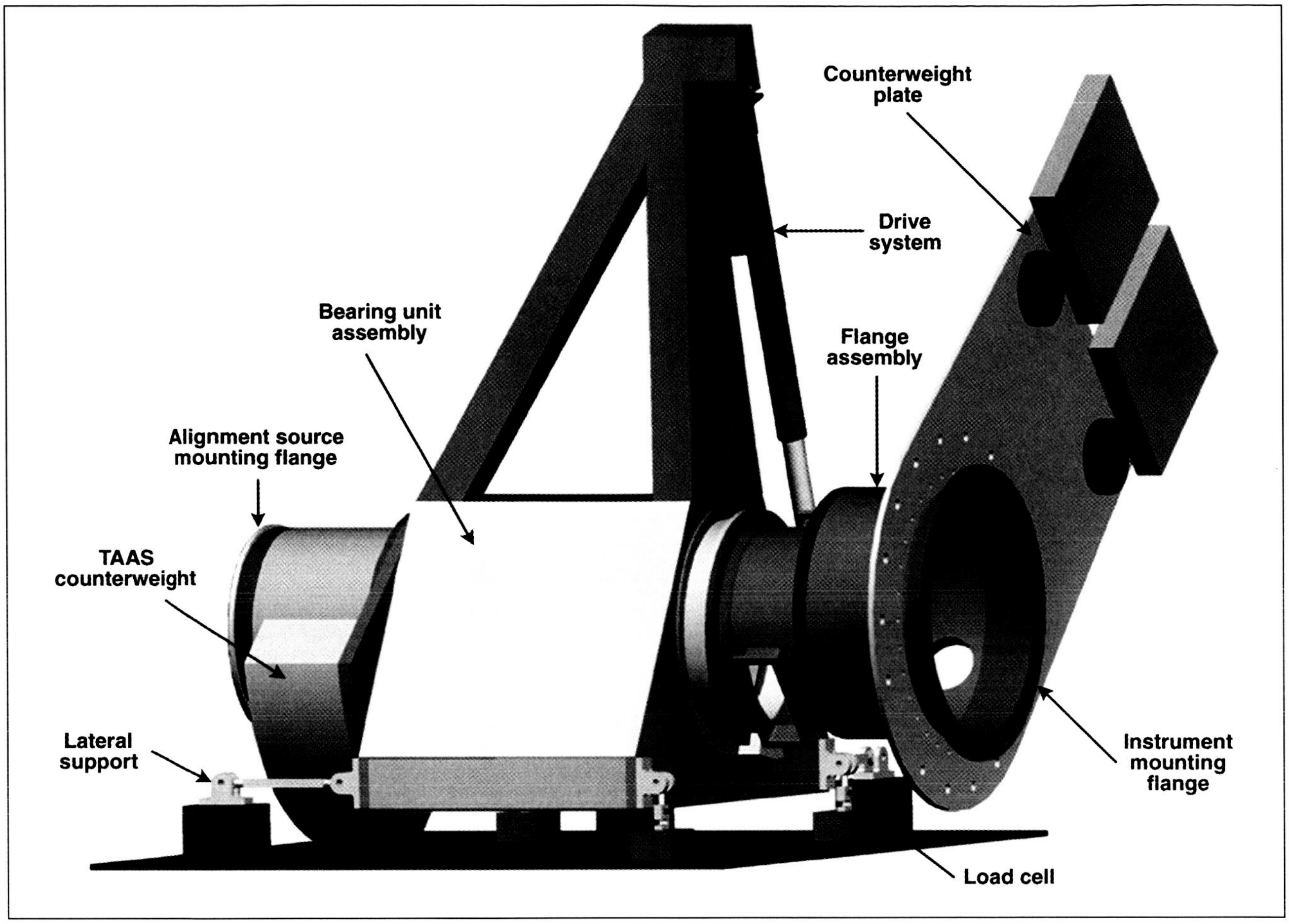

Fig. 1. An advanced design for the Telescope Assembly Alignment Simulator.

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The Center for Star Formation Studies

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The Center for Star Formation Studies is a consortium of scientists from the Space Science Division at Ames and the Astronomy Departments of the University of California at Berkeley and Santa Cruz. Under the directorship of D. Hollenbach, this consortium conducts a coordinated program of theoretical research on star and planet formation and supports postdoctoral fellows, senior visitors, and students. Consortium members meet regularly at Ames to exchange ideas and present informal seminars on current research; a week-long workshop on selected aspects of star and planet formation occurs each summer.

In July 1999 the Ames members of the Center together with members of the Stratospheric Observatory for Infrared Astronomy (SOFIA) team held an international workshop entitled "SOFIA and Star Formation." Held on the University of California at Santa Cruz campus, the week-long workshop had approximately 175 attendees. One purpose of this workshop was to bring theoretical and observational astronomers together with the instrumentalists working on SOFIA instruments in order to stimulate new ideas for SOFIA observational projects related to star formation.

One focus of the 1999 Ames portion of the research work of the Center involved the effect of ultraviolet radiation from young massive stars on the star-forming clouds of gas and dust that typically either surround them or lie close to them. Called "giant molecular clouds" or GMCs, these clouds typically contain 100,000 solar masses of gas and dust and are the dominant sites of star formation in galaxies. The GMCs consist primarily of cold molecular hydrogen gas found in a very clumpy structure bound together by gravity. Thousands of stars are formed in each cloud before it is dispersed in approximately ten million years by the ultraviolet radiation from the most massive stars formed in the GMC. The ultraviolet radiation photoevaporates the clumps in a GMC, destroys the molecules, and heats the gas until the thermal pressure creates a catastrophic expansion of the GMC. These processes disperse the cloud and terminate star formation, and thereby help explain why GMCs do not convert higher fractions of their mass into stars before evaporating into the diffuse interstellar medium. The heating of the gas leads to the emission of characteristic infrared spectra, which can be analyzed to determine the physical and dynamical properties of the evolving clouds.

Another focus of the Ames portion of the Center research in 1999 involved the formation and propagation of spiral density waves in the orbiting disks of gas and dust that circle a newly formed star and ultimately form planets. These spiral density waves affect the evolution of the density and angular momentum in these disks, and, therefore, the planet-forming characteristics of the disks. Analytic analysis and numerical simulations showed that two competing hypotheses explaining the cause of spiral structure in self-gravitating disks had an underlying unity. This finding provided a much better understanding of how mass and angular momentum are transported through protostellar disks. This work could also be generalized to the self-gravitating disks which characterize galaxies, and thereby resolve a long-standing debate in the galactic structure community.

The theoretical models of the Center have been used to interpret observational data from NASA facilities such as the Infrared Telescope Facility (IRTF), the infrared astronomical satellite (IRAS), the Hubble Space Telescope (HST), and the Infrared Space Observatory (ISO), a European space telescope with NASA collaboration, as well as from numerous ground-based radio and optical telescopes. In addition, they have been used to determine requirements on future missions such as SOFIA and the proposed Space Infrared Telescope Facility (SIRTF).

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CCD Photometry Tests for Planet Detection

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For the first time in history we now know of more planets outside our solar system than in it. All of these extrasolar planets are about the size of Jupiter or larger. The *Kepler Mission* proposes to search for hundreds of Earth-size planets. The concept consists of monitoring 100,000 stars continuously for four years for planetary transits. An Earth-sized transit of a solar-like star produces a relative change in brightness of 8×10^{-3} for a duration of a few to 16 hours, depending on the orbit and inclination of the planet. A technology demonstration showed that a relative precision of better than 2×10^{-5} is achievable when all of the realistic noise sources are incorporated in a full-up end-to-end system. A commercially available back-illuminated charged coupled device (CCD) was used for the tests. The same device can be used in the proposed *Kepler Mission*.

The technology demonstration test facility incorporated the ability to control and measure the following effects on the noise performance of the end-to-end system: varying the CCD operating temperature; changing the focus; varying the photometric aperture; operating over a dynamic range of five stellar magnitudes; working in a crowded star field; reading out the CCD without a shutter; translating the image to several discrete